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INFLUENCE OF PROBLEM BASED LEARNING MODEL ON STUDENT CREATIVE THINKING ON ELASTICITY TOPICS A MATERIAL

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ABSTRACT

The phenomenon in the classroom where teachers are still limited space to train and to improve students' creative thinking skills (CTS) on the topic of material elasticity is the main reason for this research. Information on improving students' creative thinking skills in material elasticity topics by implementing problem based learning model (PBL) in learning is also limited. Previous research has not revealed any effort related to improving students' creative thinking skills on material elasticity topics by comparing two different learning models. Therefore this study aims to reveal differences in student learning outcomes on material elasticity materials in PBL and conventional models. Based on the research results obtained information that students 'creative thinking skills scores using PBL model is higher compared with that of conventional learning. It also revealed at each meeting that the CTS indicator of students are always improve. It can be concluded that PBL is very effective in training and improving students' creative thinking skill in physics learning. Thus PBL can be recommended in improving students' creative thinking skills.

ABSTRAK

Fenomena yang terjadi di lapangan dimana guru masih terbatas ruang geraknya untuk melatih dan meningkatkan keterampilan berpikir kreatif siswa pada topik elastisitas suatu bahan menjadi alasan utama penelitian ini dilakukan. Sampai sejauh ini informasi tentang peningkatan keterampilan berpikir kreatif siswa pada topik elastisitas suatu bahan dengan model problem based learning masih terbatas. Penelitian terdahulu belum ada yang mengungkap upaya terkait peningkatan keterampilan berpikir kreatif (KBK) siswa pada topik elastisitas suatu bahan dengan membandingan dua model pembelajaran. Oleh karena itu penelitian ini bertujuan mengungkap perbedaan hasil belajar siswa pada materi elastisitas suatu bahan dengan model PBL dan Konvensional. Berdasarkan hasil penelitian diperoleh informasi bahwa keterampilan berpikir kreatif siswa pada pembelajaran dengan model PBL lebih tinggi bila dibandingkan dengan keterampilan berpikir kreatif dengan pembelajaran konvensional.Terungkap pula pada setiap pertemuan indikator KBK siswa selalu mengingkat. Dapat disimpulkan bahwa PBL sangat efektif dalam melatihdan meningkatkan KBK siswa dalam pembelajaran fisika. Dengan demikian PBL dapat direkomendasikan dalam meningkatkan KBK fisika siswa.

Keywords: Creative thinking skills; Elasticity; PBL

INTRODUCTION

The 21st century learning program has launched significant changes in learning methods by involving students in every learning activity (Tindowen, Bassig, & Cagebas, 2017). To create a sophisticated learning the teacher should be able to act as a facilitator who gives the greatest opportunity to the students to express themselves in the learning process (Kim, Lee, Youn, Eom, & Lee, 2015; Eom, Youn, Kim, 2016). Dynamic learning will provide wider space for students to explore and train their skills. Skills which developed through dynamic

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learning are skills related to ideas managed by memory and are poured in the form of quality products (Plucker, Beghetto, & Dow, 2004).

Over the past few centuries, the role and excellence of creativity in education has transformed the United States into a developed country. Some scientists argue that the idea of creativity since the 1960s that is so prominent in the field of education has prompted the USA education system to experience a very big revolution (Feldman & Benjamin, 2006). This proves that creative ideas have the opportunity to build a better education system. Creativity and learning skills, described as something that must be nurtured continuously (Wegerif & Dawes, 2004). In a study of technology-based learning and creativity, it shows that creativity thinking enables one to produce high-quality work and provides more creative opportunities (Loveless, 2002).

Finland as one of the best educational systems in the world, its people greatly appreciates the role of creativity and education that can transform education into higher quality for the future (Fullan, 2009). The same fact also happened in England, China, and the Republic of Kazakhstan who realized the importance of educating creative individuals in building a nation. This confirms that the developed nation from all aspects of life comes from creative people (Cox 2005; Tischler 2006; Massyrova, Sandibayeva, Kaptagai, Kopenbayeva, & Aidarbekova, 2015).

Students are the golden generation that will greatly color the order of life of previous generations. Therefore cultivation of the value of the importance of mastering the learning skills to the students greatly determines the expected gold generation profile (Chuvgunova & Kostromina, 2017). The role of teachers is necessary in fostering students' creative thinking skills. It requires enough time and effort to plan, design, implement, and evaluate learning activities (Hancer, 2013). Creative ideas can be implemented both anytime and anywhere. But, the learning process, creative thinking skills are expected to appear in students better (Ramankulov, Usembayevaa, Berdia, Omarova, Baimukhanbetova, Shektibayeva, 2016).

Creativity is shaped by the human cognitive ability to solve problems and produce new products that are rarely thought of by others (Boltz, Henriksen, Mishra, Henriksen, 2014; Hamza & Hassan, 2015). Often people think that creativity only belongs to an architect or genius. This is not entirely true. Creativity is already owned by everyone since birth. Therefore everyone has the potential to be developed creativity (Trilling & Fadel, 2009). Physics is the lesson that trains Creative Thinking Skills (CTS) students (Dambueva, 2014). Another view also suggests that CTS can improve problem-solving skills, train cognitive abilities, and students' emotional intelligence (Clinton & Hokanson, 2011; Forgeard & Eichner, 2014).

Research of collaborative learning using PBL model to improve creative thinking skill for material elasticity material is still few. Similar research examines different content, eg physics science learning (Rahayu, Susanto, & Yuliati, 2011; Panjaitan, Nur & Jatmiko, 2015) and water purification (Rev., 2016). Learning 21st century is expected to improve students' creative thinking skills and no longer use anonymous learning, but using models that can improve student CTS. One of the learning models that facilitate students to improve their CTS is the PBL model (Ersoy & Baser, 2014). In addition PBL helps students in achieving educational goals, in problem solving, peer-to-peer collaboration, and lifelong learning (Tan, 2009).

In the recent era, the most fundamental goal of physics learning is to educate individuals who can conduct research, investigate, and build correlations between physics concept by using existing environments. Physical learning is a scientific method for having problem-solving skills and having an attitude toward life from a scientist's point of view. The quality of learning in Indonesia is still low due to teachers teaching style in using traditional learning-based models and tends to be less empowering the existing environment to improve student learning outcomes (Dwijananti & Yuliati, 2010).

The syntax of PBL learning has been widely studied by educational experts. One of them is proposed by Arends (2012) as in Table 1. The learning process using the PBL model invites students to become a creative scientist in solving problems. This is marked by the problems that students and teachers can emerge; then through the process of discussion students can deepen their knowledge of what they know; and learn the steps to solve the problem; working in groups and helping each other so that they can collaborate in solving problems (Setyorini, Sukiswo, & Subali, 2011). Through the PBL learning model with heterogeneous group members; allows students to exchange ideas; work together to solve problems; and express their ideas; which ultimately can improve students' creative thinking ability (Meissner, 2006).

Thus, this study aims to reveal differences in students' creative thinking skills on the topic of elasticity of a material with PBL and conventional models based on lectures.

METHODS

This study is a quasi-experimental study. The populations in this study are students of class X Science. The samples in this study were 77 students, those who were determined randomly. The sample of the study was selected from one of the high school schools in Malang which has status as a moderate level school. Classes used in this research are experimental class (n = 38) and control class (n = 39). The topics presented are elastic and non-elastic, the concept of stress and strain, Young's modulus, Hooke's law, and parallel series spring arrangement.

The research instrument used is a CTS test question in the form of a description of 15 items. The developed instrument has been validated by theoretical physics and physics education experts from the State University of Malang. The instrument was developed based on four indicators of creative thinking skills, namely indicators of fluency, flexibility, originality, and elaboration (Munandar, 2002). The CTS instrument has been empirically tested, so that information about validation and reliability are 0.72 and 0.94 respectively. The rubric used to assess students' answers refers to Hart's scale (1994) with guidelines on the rubric of creative thinking skills developed. On that scale there are five categories, they are, if the students answer three aspects of the answer or more given a score of four, if the students answer two aspects of the answer given a score of three, if students answer one aspect of the answer given a score of two, if the student tried to answer but wrong answer given score one, and no answer at all given a score of zero.

The data of the research were analyzed by ancova test to reveal the difference of students' creative thinking skill in control class and experiment class. The first step before the data

Table 1. Syntax of Problem Based Learning Model (PBL) According to Arends (2012)

Steps (Phase)	Teacher Activities	Students Activities
Phase 1 Orientation of students to problems and hypotheses	▪ Teacher delivers learning objectives and organizes students in questioning and problem-solving activities. ▪ Teacher invites the students to hypothesize the problem.	▪ Students listen to the teacher's explanation of the issues discussed and observe the phenomenon presented. ▪ Students develop hypotheses on the given problem.
Phase 2 Organize students to learn	▪ Teacher forms groups of students consisting of 5 students in one group.	▪ Students are grouped according to teacher's instructions.
Phase 3 Guiding individual and group investigations	▪ Teacher guides students in conducting experiments.	▪ Students conduct experiments, observe, and analyze experimental results.
Phase 4 Develop and present the work	▪ Teacher assists students in completing reports on student worksheets. ▪ Teacher chooses group representatives to present their work to other groups to develop the results of the investigation.	▪ Students conduct group discussions in analyzing observation data and presenting the work. ▪ Students communicate the results of their experiments and conduct class discussions by commenting on the results of other groups' investigations.
Phase 5 Analyze and evaluate the problem-solving process	▪ Teacher helps students to reflect on their inquiry process. ▪ The teacher guides the student toward the correct solution of the problem in accordance with theoretical physics. ▪ Teachers strengthen the learning materials related to the problem. ▪ Teacher gives a quiz.	▪ Students analyze experimental results and conduct class discussions to conclude experimental results. ▪ Students improve their problem solving solutions that are not yet compatible with theoretical physics. ▪ Students pay attention to teacher strengthening. ▪ Students associate their understanding gained during learning into quiz answers.

analysis is the prerequisite tests, the normality and homogeneity test. The results of both prerequisite tests indicate that the distribution of data in the control and experimental groups are normal and homogeneous.

RESULTS AND DISCUSSION

This research is aimed to know the difference of creative thinking skills between students who experience PBL based learning and those who conventionally taught. The prerequisite test has been met, so to obtain the information can be done by hypothesis test using single ancova statistical test as shown in Table 2.

Table 2. Results of single ancova statistical test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6267.32[a]	2	3133.66	42.74	.000
Intercept	37140.41	1	37140.41	506.61	.000
XCreative	59.86	1	59.86	.82	.369
Model	6253.66	1	6253.66	85.30	.000
Error	5425.03	74	73.31		
Total	385036.11	77			
Corrected Total	11692.35	76			
a. R Squared = .536 (Adjusted R Squared = .523)					

Table 2 shows the significance of learning model (0.000) less than alpha (0.05) which means there are differences in creative thinking skills based on PBL and conventional learning model. Information on different learning models of significance between the two models is shown by the LSD test. The LSD test is a further test to determine the magnitude of the difference in creativity between PBL and conventional learning models as presented in Table 3. The LSD test results inform the difference in average students' creative thinking skills. In PBL learning, CTS scores of the students are higher than students who experience conventional learning. Associated with the percentage of CTS improvement, it was revealed that students' creative thinking skills in the classroom with PBL learning increased compared with students in the conventional learning class.

The research data shows more clearly that there are differences in CTS scores between PBL classes and conventional classes. The PBL model can facilitate students to improve students' creative thinking skills in the field of physics and improve learning (Dariyo, 2003). Figure 1 below shows an increase in CTS scores on each indicator at each meeting. In the learning process appears to be an increase in CTS score indicating that students are able to be at a very creative level.

The positive shift towards learning outcomes related to CTS scores is a thought of the formation of creative generation that has the potential to solve complex social and environmental problems (Yusnaeni, Corebima, Susilo, Zubaidah, 2017). Hotaman (2008) also revealed that CTS is the ability to make connections between concepts previously created and generate new and original thinking experiences as new patterns.

The shift of CTS based on the results gives an idea that students are beginning to change their thinking patterns better. If this continuous effort is maintained then the individual will experience a tremendous change. Creative people are very influential on the progress of a country. The advanced country depends heavily on creative people. In relation to the learning process and if this habit pattern is maintained optimally, the government will benefit from the success of education that students' thinking is already at a higher level. The results of the study (Khanafiyah & Rusilowati, 2010) reported that student CTS only at creative level were 78.3%, creative 20% and 1.7% very creative. All achievements of depend on the teacher in training students with creative thinking.

The phase in the PBL that can improve the CTS students is in the phase where students do orientation activities on the problem and create a hypothesis. In this phase students are given problems related to the phenomenon in everyday life. Teacher shows several videos related to the elasticity of a material for examp-

Table 3. LSD Test Results Differences in Students CTS Scores Based on Learning Model

Model	X-CTS	Y-CTS	df	Creative Corr.	Notation
PBL	26.32	78.73	52.41	78.78	a
Conventional	27.27	60.63	33.37	60.73	b

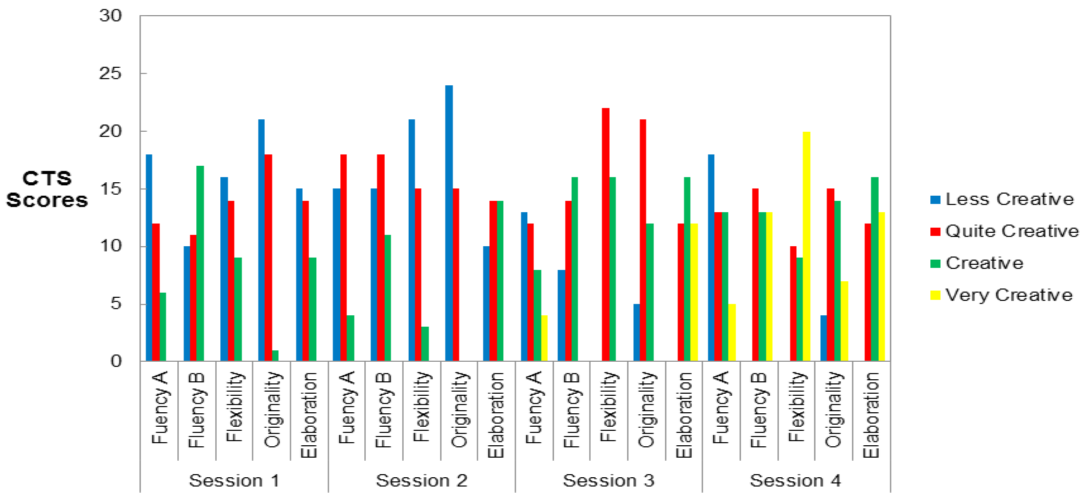


Figure 1. Improvement of CTS Scores on Each Indicators at Each Session

le in the sub topic of elastic and plastic subjects. One of the videos that aired was a high lump athlete who would make a jump using a pole to cross the ruler with a height of 4.5 m, as shown in Figure 2.

Figure 2. An athlete who is trying to get past the ruler with a height of 4.5 m using pole support.

Based on the video story, the teacher asks the students with the following questions "express your opinion about what opportunities that allow an athlete to cross the ruler". The answer of student S1: "1) the stick used by the athlete is made of elastic material, thus allowing the athlete to pass the ruler, 2) the force given is large enough due to mass influence and instantaneous/impulse speed, 3) the position of the athlete's grip on end of the pole so as to provide a high enough leap, 3) running speed is arranged in such a way that it can help make the jump and 5) the precision of the athlete. In this case the aspect shown by the students is on the fluency indicator. The questions given can train the students' CTS, so students will use all their skills to answer questions from the teacher.

Currently, PBL model is among the methods that provide universal benefits such as determining problems, investigating the causes, hypothesizing, testing hypotheses, obtaining information, and setting learning targets, developing problem-solving skills, and using information obtained from real life (Chin & Chian, 2004). In addition, the PBL model has many benefits such as student-centered learning; helps students to develop mindsets from different perspectives; conducting more in-depth, active, and meaningful learning; as well as improving the ability to think creatively and think critically of students (Alrahlah, 2016).

Phase of analyzing and evaluating problem-solving process. In this phase the teacher re-do reflection on the learning that has been done. The teacher displays a video about the events in everyday life as shown in Figure 3. From the case presented the teacher gives a question to the students. "In everyday life you may have experienced or seen cases of accidents like this and the result is death or disability. My question is "how to design your helmet so that when a collision happens, you will be safe" (Indicator Originality).

As for the student S25 answer "1) make an anti-concussion helmet where the structure in the helmet is equipped with elastic material such as thick sponge so that at the time of collision with hard objects such as road or other vehicle elastic material or sponge can protect the head, 2). Vibration distribution tools throughout the body, 3). The helmet is equipped with a thick Styrofoam as an elastic material to protect the head during impact. Based on existing information, this phenomenon can train students' CTS.

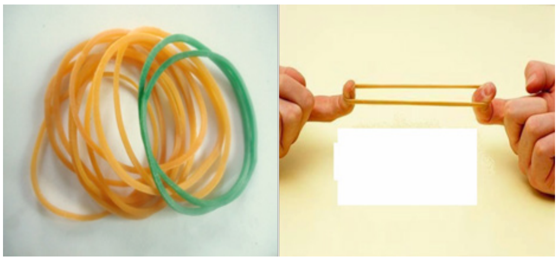
Figure 3. Views of Traffic Accidents

In the phase of analyzing and evaluating the problem-solving process, students are given questions related to the learning that has been implemented. To find out the progress of the students, the teacher evaluates by giving different questions but in the studied topics of stress, strain, and Young module. The teacher questions as follows. Consider the following video, our brothers in one of the villages in East Kalimantan have to struggle through a bridge made of rope. If there are a lot of students passing through this rope, then most likely what happens is the rope will become tense and broken so they will fall into the river. If you as the head of the village with such a minimal budget explain what things you can do so that the bridge strap does not tighten and break.

Figure 4. A number of students struggling across the river with a bridge made of rope

The answer of the student S23 "1) the thing that can be done is replacing the existing rope with a large diameter steel wire. Thus, the steel wire balances the mass of passersby, 2) replacing it with a larger diameter rope, 3) limiting the number of passersby thereby reducing the load of the rope to strain, 3) assisted with the support and placed in the center, and 4) create a simple bridge made of bamboo.

Another phase that could potentially improve students' CTS is guiding individual and group investigations. Questions given on the student worksheet will answer the questions in accordance with the instructions on the worksheet. The problem is as follows. "Consider some of the pictures below, first the rubber in the initial state when given the style then the rubber will change shape, after the force is removed then the rubber will return to its original state as shown in Figure (a). Give a detailed explanation of the events in the picture."



(a) (b)

Figure 5. Elasticity of Hair Rubber

As for the answer of student S30 "1) on the phenomenon of picture A, it is seen that the rubber is still in normal condition, it corresponds to Newton's legal theorem which states that if an object does not give the force then it will remain in normal condition 2) there is a change in the shape of rubber, this is because there is a force effect given to the rubber so that the rubber undergoes a shape change (elongated) and if the tensile force is removed then the rubber will return to its original shape is the nature of perfect elasticity. 3) based on Hooke's legal view, if the tensile force does not exceed the elasticity limit of the rubber, the increment of rubber length is directly proportional to its tensile strength.

CONCLUSION

Based on the discussion, it can be concluded that by applying the PBL model students' creative thinking skills on the topic of elasticity of a material can be improve. Learning using the PBL model has a great opportunity to improve students CTS better than that of conventional learning. Thus PBL can be recommended in improving students CTS in physics learning.

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